

SOIL SURVEY OF WINN PARISH, LOUISIANA.

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DESCRIPTION OF THE AREA.

Winn Parish is located in the longleaf pine hill section of northwest Louisiana, between the Red and Mississippi rivers. It is included within parallels $31^{\circ} 42' 32''$ and $32^{\circ} 8' 53''$ north latitude and meridians $92^{\circ} 18' 43''$ and $92^{\circ} 58' 23''$ west from Greenwich. It is bounded on the north by Bienville and Jackson parishes, on the east by Caldwell and Catahoula parishes, on the south by Grant Parish, and on the west by Natchitoches Parish. The thriving town of

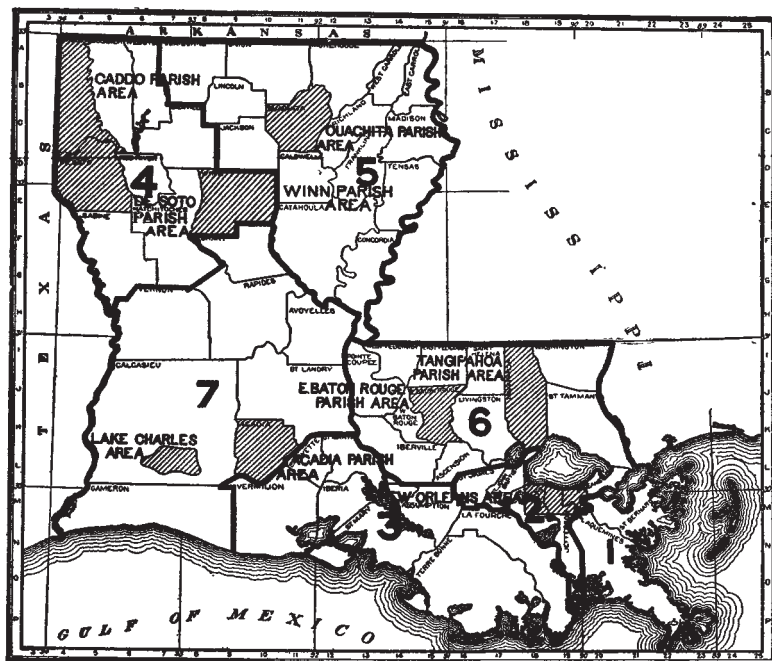


FIG. 18.—Sketch map showing location of the Winn Parish area, Louisiana.

Winnfield, the parish seat, which has a population of over 4,000, is located about the geographic center of the parish. This town has become a railway center of considerable importance within the last few years. Geographically the parish lies in the Mississippi embayment, and the geological period represented is principally the Tertiary Eocene. There are 614,528 acres or about 960 square miles in the parish.

Most of the base map showing towns, roads, railways, streams, branches, houses, churches, and schoolhouses was constructed with the plane table by an experienced traverseman from the Geological Survey, as the soil mapping progressed. A small portion of the traverse around Winnfield, however, had been done by Prof. G. D. Harris, State Geologist of Louisiana, and his map was somewhat enlarged upon later by the U. S. Geological Survey in making a 15-minute quadrangle. The scale of the base map is 1 inch to 1 mile.

The area is well supplied with streams and branches. The Red River forms the boundary for a few miles in the southwest corner. The main drainage, however, passes through the Dugdemona River, which crosses the parish diagonally from the northwest to the southeast corner, dividing the area into about equal parts. Where this stream leaves the parish the altitude is about 50 feet above tide, while the highest point in the area is something over 300 feet, so that there is a range in elevation of about 250 feet. The area slopes gradually toward the southeast and all of the larger streams flow in the same direction and are more or less parallel to the Dugdemona and Red rivers. With the exception of the rather abrupt hills bordering the Red River and the Saline Bayou, the slopes bordering all the larger streams are gradual, and the streams themselves usually follow tortuous courses, through wide swamps, skirting which are often wide stretches of second bottoms (flat woods), the flood plains of former times. The ridges of lower elevation are usually broad and rather flat and in these the drainage is not yet well established; while those of higher elevation are hilly and often broken and the drainage and erosion are sometimes excessive. All of the drainage of the area eventually reaches the Gulf through the Red and Mississippi rivers.

In the colonial days of Louisiana the French made many settlements along the large water courses, and the territory comprised now in Winn Parish attracted a number of French families along the Red River and Saline Bayou. No permanent American settlements took place in the region until about the middle of the second quarter of the last century. Winn Parish was organized in 1852, and has since been greatly reduced in size by the organization of other parishes out of its territory.

Some of the early military and immigrant trails to Mexico and Texas crossed the parish, and these old overland routes were the scenes of great activity, and especially so when Texas was being colonized by Americans. The immigrants came mostly from Kentucky, Tennessee, Georgia, Alabama, and Mississippi; and in their westward journey across the country many were attracted by the good fishing and hunting and the excellent range and pasture for hogs and cattle in the numerous large swamps of what is now Winn Parish. Some

did not complete the trip to Texas, and some who did so came back to take advantage of the free and easy life of stock raising and fishing and hunting.

The present farming population of the parish is made up largely of the descendants of these immigrants, the early French families having given way entirely to Americans. About 5 per cent of the farming population of the parish is made up of negro property owners and tenants. There has been a great increase in population around the larger towns, owing to the lumbering interests and railroad construction. A large per cent of this increased population is made up of colored people, who came from widely separated sections, while the increased white population is made up mostly of people from Arkansas and Missouri.

Over the greater part of the parish the settlements are few and far between. Not more than 10 per cent of the land has ever been cleared and cultivated and the remainder is still covered either with virgin forests or slashings. The recent activity in lumbering and the high prices paid for timber lands have caused some to leave their farms to engage in day labor about the mills, and others to dispose of their entire holdings to the lumber companies. The result is that in many localities fields once cleared are growing up to brush and briars, and farmhouses once the homes of thrifty farmers are vacant and tumbling down. All of the public land has been taken up and has fallen largely into the hands of the larger lumber companies.

The crops are fenced and all stock turned at large. The roads are poorly kept and but few of the stream crossings are bridged. There is as yet no rural free delivery of mail. The telephone is just beginning to enter the homes of the most progressive farmers.

Winnfield, Dodson, Atlanta, Calvin, St. Maurice, Lofton, and Coldwater, all of which are located on railways, are the chief towns of the parish.

In the early days Trenton, Monroe, and Columbia, on the Ouachita River, and Montgomery and Alexandria, on the Red River, furnished the principal markets. Practically all who lived north of Dugdemona River swamp went to the points on the Ouachita, while those living south of the swamp went to the points on the Red River, the difficulties of crossing the Dugdemona swamp causing the division. Live stock were driven to market, and the cotton was hauled by oxen and often two weeks was consumed by the trip. In high-water time in winter the Dugdemona, Saline, and Castor streams permitted small boats to ascend into the parish, but very little of the farm products were marketed in this way, forest products forming the bulk of the traffic. During the dry season the Red and Ouachita rivers sometimes became so low as to stop navigation and the people were occasionally cut off from mail and supplies.

About a score of years ago, when the Vicksburg, Shreveport and Pacific Railway was extended westward from Monroe, Ruston became a popular market for a large part of the parish.

The year 1900 was the beginning of a new era for the agricultural interests of Winn Parish. In that year the Arkansas Southern Railroad was built from Ruston to Winnfield, being attracted thither largely by the increasing importance of the lumber interests. A short time afterwards the Louisiana and Arkansas was built from Sibley to Winnfield, and since that time Winnfield has continued to grow in importance as a railway center. The Louisiana and Arkansas Railway had been extended to Alexandria and a branch of it to Jena. The Winnfield branch of the Louisiana Railway and Navigation Company terminates at Winnfield and connects it with Alexandria and Shreveport. Winnfield is also the terminus of the Tremont and Gulf Railroad, which extends southward from Tremont, situated on the Vicksburg, Shreveport and Pacific Railway. The main line of the Louisiana Railway and Navigation Company passes through St. Maurice in the southwestern corner of the parish and the Iron Mountain Railway crosses the extreme southeastern corner of the parish and furnishes transportation facilities for that section. The new towns and numerous sawmill communities furnish a great demand for all kinds of farm and garden produce.

The farmers of Winn Parish being unaccustomed to the advantages of good markets and the benefits of modern railway transportation, have confined their efforts to the cultivation of their small clearings and have placed a large part of their dependence upon hogs and cattle, which are branded and run at large. It will take some time to adjust the agriculture to the changed conditions.

CLIMATE.

The climate of the area is temperate, the average annual temperature being about 65.5° F. The coldest weather occurs in December, January, and February, when the mercury seldom goes below the freezing point for more than two or three days at a time. Owing to the great humidity of the air, however, freezing weather is often felt with greater severity than farther north and west where the humidity is less.

Spring opens the latter part of March or the first part of April, during which months the fields are prepared and planted to cotton and corn. The average date of the last killing frost at this season is about March 24, but as the area sometimes lies in the path of the "northers," during the spring, truck and fruit and the tender cotton and corn plants are occasionally injured as late as the first week in April.

The summer months, June, July, and August, have an average temperature of about 82° F. After this the weather begins to cool gradually until the latter part of October, when light frosts may be expected. The average date of the first killing frost in the fall is about November 2, making the average length of the growing season about seven and one-fourth months. Thus it can be seen that the region has the long season necessary for the production of cotton and corn and other slow-maturing crops. The season is sufficiently long to permit of the growing and gathering of two crops of Irish potatoes, and many rotations can be followed that allow the harvesting of several crops on the same land in a single season.

The average annual precipitation is about 50 inches, and from November to the latter part of July the average rate of rainfall is 4½ inches per month. Occasionally there is a spring of excessive cold rains and this usually necessitates a great deal of replanting of cotton and corn. During August, September, and October the rainfall drops off to an average of about 2.9 inches per month, but as this is past the growing season no great amount of damage is done. The climate of the area is admirably adapted to the growing of small fruits, vegetables, and truck crops in general.

There being no Weather Bureau stations in Winn Parish, the following tables are compiled from records kept at Liberty Hill in the adjoining parish of Bienville. The figures are believed to be fairly representative of the local climatic conditions.

Normal monthly and annual temperature and precipitation at Liberty Hill, Bienville Parish.

Month.	Temperature.	Precipitation.	Month.	Temperature.	Precipitation.
	° F.	In.		° F.	In.
January.....	47.6	4.94	August.....	82.3	2.83
February.....	49.5	4.19	September.....	75.6	2.95
March.....	58.1	5.61	October.....	66.3	3.02
April.....	65.9	4.64	November.....	56.3	4.13
May.....	73.3	3.39	December.....	49.2	4.75
June.....	79.8	5.06			
July.....	82.4	4.87	Year.....	65.5	50.38

Occurrence of killing frosts at Liberty Hill, Bienville Parish.

Year.	Last in spring.	First in fall.	Year.	Last in spring.	First in fall.
1898.....	Apr. 7	Oct. 27	1904.....	Mar. 28	Nov. 11
1899.....	Mar. 29	Nov. 3	1906.....	Apr. 1	Oct. 29
1900.....	Apr. 1	Nov. 10	1907.....	Feb. 16	Oct. 14
1901.....	Apr. 3	Nov. 6			
1902.....	Mar. 6	Nov. 27	Average.....	Mar. 24	Nov. 2
1903.....	Mar. 25	Oct. 19			

AGRICULTURE.

The first settlers chose the region because of its special adaptation to stock raising. The numerous large swamps were forested principally with oaks and beech, and these furnished an inexhaustible mast for hogs. The swamps were also filled with dense canebrakes, and sometimes the cane extended out and covered the hills of lower elevation. This furnished excellent pasturage for cattle, and especially so during the winter months, when the wild grass pasturage on the hills was short.

The region was not settled rapidly because of its remoteness from navigable streams and the absence of railways, and for these reasons, largely, the conditions which existed over the greater portion of Winn Parish in 1900, when the first railway was constructed to Winnfield, were very similar to the conditions which existed there fifty years before.

The early settlers constructed for themselves log houses and barns, deadened a small patch of timber, and fenced in the whole. Each one strove only to produce enough corn, fruit, and vegetables to supply his family. The hogs were marked and the cattle branded and allowed to run at large in the swamps and woods. Later the stock was driven to market, and usually ten days or two weeks were consumed in the journey. Whatever surplus of farm products was produced was also hauled to market at Monroe or Alexandria in ox wagons. Outside of the Red River bottoms very little cotton has, until recently, ever been grown in the parish. Stock furnished practically the only source of revenue. Until about a decade ago the parish was so sparsely settled and so little value was placed upon the land that the settlers were not strongly attached to any one locality and frequently moved from one place to another. The importance of acquiring possession of the land and timber, either by homesteading or by direct purchase from the Government, did not impress itself upon them. The necessity of having to pay taxes caused many to have an aversion to acquiring legal possession, and until recent years there were many families who had lived in the parish for forty or fifty years and had never owned any land. The great difficulty of making clearings and the rapidity with which these clearings would grow up when once neglected or abandoned caused the people to regard the timber as an enemy. The great value of the pine and oak forests was not appreciated until the northern lumbermen appeared and began paying from \$1 to \$2 an acre for the land and timber. This was about twenty years ago, and since then there has been a steady increase in values, until some of the same land is now held at from \$25 to \$40 an acre. The timber lands have gradually fallen into the hands of the large companies, so that at present only about one-fourth of the lands and timber of the entire parish is owned by the original settlers or their de-

scendants. The great amount of labor employed on the railways and about the logging camps and sawmills has created an unsatisfied demand for all sorts of farm products, and the result of this has been to stimulate agriculture throughout the area. The most progressive farmers are striving to satisfy the local demands with vegetables, fruit, and meat. Stock raising, especially hog raising, has fallen off considerably, largely for the reason that with the destruction of the oak timber for staves the supply of mast has been greatly reduced.

Within the last few years considerable cotton has been grown in the hill section of the parish. The small portion of the area in the Red River bottoms has always been celebrated for its production of cotton. Practically all of the farmers in the hill section do their own work, while those on the Red River employ negro tenants. The general type of agriculture in practice at present is largely that in use in other hill sections of the State prior to the civil war. The people never were large slave owners, and were therefore accustomed to doing all of their own work. The principal products of the parish at present are cotton, corn, potatoes, vegetables, and forest products, the latter far exceeding in value all other products. The cotton crop is becoming greater each year, as the timber is being removed and more settlements are being made. The corn crop is secondary to cotton, and there is great room and need for expansion in growing this crop. The potato crop has not as yet assumed any great importance, but it bids fair to do so in the near future. The vegetables at present grown are principally those for home use.

It is generally recognized that the sandy upland soils are better adapted to cotton than to corn, while in case of the bottom-land soils the best yields of cotton are obtained upon the heavier soils. Cotton seems to thrive better upon heavy soils or upon those which have a heavy subsoil, while corn does best either upon the sandy bottom-land soils or the heavier upland soils. Sweet and Irish potatoes and all kinds of small vegetables thrive best upon the sandy upland soils. Sorghum and sugar cane do best upon the small branch bottom soils, while alfalfa thrives upon the heavy clay of the Red River bottom. The sandy gravelly ridges and hills of the highest elevation are the best for peaches, and in the early days a good grade of tobacco was grown upon them for home use.

There is practically no systematic rotation of crops practiced in the parish, cotton often following cotton until the yield decreases to a point where it is no longer profitable and the field then abandoned and allowed to grow up to brush and weeds. The acreage of corn is small compared with cotton, and the general type of farming may be considered a one-crop system.

Shallow plowing and shallow cultivation is the customary practice upon light and heavy soils alike, and all of the crops are culti-

vated in ridges regardless of location or kind of soil. No green manuring is done, and practically none of the barnyard manure is applied to the fields. In the winter time nothing is done to protect the bare fields from the damaging effects of leaching and erosion. The result is that both the upland and bottom soils are rapidly losing their original productiveness, and instead of building up and maintaining the fields already cleared, the farmers, in order to keep up their cotton production, usually bring new or fresh land under the plow every few years and allow the old fields to gully and wash and become reforested.

As before stated, practically all of the farms in the parish are operated by the owners, and the only exception to this is in the small strip of Red River bottoms, where the custom of letting the land out under the tenant system seems well established.

In recent years the tenant system practiced in the Red River bottoms has been more unsatisfactory than usual, owing to the ravages of the boll weevil and the fear of the colored people that they would not have anything for their year's work. The Red River planters, however, are remedying this by turning their attention to alfalfa growing.

The average size of the farms is about 150 acres; the holdings, however, range from a few acres to several thousand, and some of the larger timber concerns own as high as 50,000 acres.

The price of cleared and improved agricultural land varies with its location, the character of the soil, and the condition of the farm buildings. The average price, however, in the hill section ranges from \$5 to \$15 an acre. In the Red River bottoms the value of such land is much higher, the price ranging from \$25 to \$50 an acre, and some of the land can not be purchased at any figure. The timber land of the parish varies greatly in value, according to location and the amount of merchantable timber standing. The prices range from \$10 to \$40 an acre.

There is much to be said by way of suggestion for the improvement of the agriculture of the area. The things of most importance are rotation of crops, greater diversification of crops, thorough preparation of the soil, and the protection of the soil from the damaging effects of leaching and washing during the winter months. The rotation suggested as best suited to the conditions in Winn Parish is cotton one year, followed by corn and cowpeas, the latter to be sown at the last cultivation of the corn. Deep plowing (that is, to a depth of 7 or 8 inches) and a thorough preparation of the soil is half the cultivation. On the sandy types of good drainage, where so steep as to be subjected to serious erosion, the soil should be broken flat with a disk instead of being broken in high ridges. If the land is inclined to wash seriously this can often be stopped by terracing. If terracing is

not done such lands should be broken into high ridges encircling the hill. The close sticky soils like Houston clay, Susquehanna clay, Miller clay, and the Greenville loam should never be broken flat, but should be broken into high ridges. Another very desirable practice in connection with the thorough preparation of the soil is fall plowing, and the advantages of this are many. The air is allowed to penetrate the soil, and the alternate freezing and thawing of the soil have a tendency to loosen up the tight, stiff land, thus putting it in better tilth and insuring a better seed bed for the next crop. During the winter months much of the inert plant food is broken down, dissolved, and converted into a form available for plants the next season. Another desirable effect of deep, careful fall plowing is that it enables the soil to absorb and store up the winter rains, thus placing at the disposal of the plant roots for the next year a larger quantity of moisture, mitigating the effects of the drougthy conditions which usually prevail in August and September. In order to get the best effects of fall plowing upon Houston clay, Susquehanna clay, Miller clay, and Greenville loam, these types should be tile drained, otherwise the soil will be inclined to run together and pack and thus increase its tendency to bake.

If care is not taken, the fall-plowed lands will wash badly during the winter months and the plant food rendered available by the processes mentioned above will be leached out by the abundant rains, which usually occur during January and February. In order to avoid these losses and the loss of fertilizers already in the soil the growing of winter cover crops like the rust-proof oat, crimson clover, wheat, hairy vetch, and the dwarf Essex rape is strongly recommended. On the light sandy soils the oat crop is the safest grain crop that can be grown, and if the ground is broken deeply in September sufficient moisture will be saved to insure a stand, and the oats will furnish an abundance of unsurpassed winter grazing for stock. The grazing of the oats during the winter, if the stand is good and they are on good land, does not injure them, but will actually improve the yield. Wheat sown upon good land furnishes a winter pasture nearly equal to oats. The yield of grain, however, is uncertain.

Crimson clover should be sown early if it is to furnish any winter grazing. It is best for grazing in the early spring. It is not advisable to cut it as a hay crop, because it is too woody; but it is a legume, and as a soil builder has great value. Crimson clover would do best upon such types as Houston clay, Susquehanna clay, Greenville loam, and Miller clay. The hairy vetch is also a legume, and is a very satisfactory winter cover crop upon the lighter types of soil. The land, however, must be well prepared and well manured.

All the winter cover crops more than pay for themselves in the excellent winter grazing which they furnish, and if the land is

wanted for cotton or corn before they mature the farmers can well afford to turn them into his soil in the green stage in February and thus get a profit in the vegetable matter added to his soil.

The recent appearance of the boll weevil in this section of Louisiana has caused the farmers a great deal of anxiety. It is believed, however, that the pest is proving to be a blessing in disguise, because the uncertainty of the cotton crop is inducing the progressive farmers to diversify more, and instead of growing all cotton and buying everything with cotton money they are beginning to plant more corn and grow more of the home necessities. A few of the most progressive farmers, however, are convinced that they can grow cotton in spite of the boll weevil, and they are basing their convictions upon what has been done in parts of Texas where the weevil has been for years. The successful plan for combating the weevil and the one advocated by Doctor Knapp and his agents in this section is briefly as follows: Grow the cotton as a surplus and not as the main money crop; prepare the soil thoroughly, and plant early. Growing cotton under boll-weevil conditions really resolves itself into a race between the farmer and the pest. The weevils do not appear in great numbers until July, and if the farmer can get his cotton sufficiently far advanced before that date he will be able to make a crop. In order to accomplish this the cotton should be planted in rows far apart, so as to insure an abundance of sunshine upon the entire plant, for shady, damp conditions are especially favorable for the weevil. In order to hasten the growth of the cotton plants frequent shallow cultivation is very essential, and in passing between the rows it is well to attach a short stick to each end of the whiffletree, so as to shake the cotton stalks as much as possible without injury. This knocks off the loose punctured bolls, as well as many of the weevils, a part of which perish in the hot sand. It is well to gather up the punctured bolls and burn them. All of this requires much labor and attention, but if cotton is grown as a surplus only, a few acres will be used where now many are cultivated, and it is safe to say that double the yields per acre can be obtained under this system.

SOILS.

The soils of the parish fall naturally into three divisions, namely, the upland soils, the second-bottom soils, and the soils of the Red River bottoms.

The upland soils consist largely of fine sandy loams, fine sands, and occasionally clays, and are derived mainly from the direct weathering of the underlying formations. These belong to the Lower Claiborne, Eocene, and consist of interstratified beds of fine sand, fine sandy clay, and clay, some of which are semiconsolidated. The beds are

everywhere nearly horizontal, and the character of the underlying material—especially the ease with which it erodes—seems to be the chief cause of the differences in topography. The erosion of the upland types is likely to be excessive.

The greater number of soil types encountered in the parish are found in the upland division. They belong, with two exceptions, in the following soil series: Norfolk, Orangeburg, Susquehanna, and Houston, all of which are common throughout the Atlantic coast and Gulf States, and have been mapped and classified in various other areas surveyed.

The second soil division is found associated with the uplands, but occurs as second bottoms bordering the swamps skirting some of the larger streams. It is represented by the single soil type Caddo fine sandy loam. Its surface is flat, and because of this fact, as well as the close, silty, clayey, impervious nature of the subsoil, the drainage is very poor. It is derived from the Port Hudson formation, and considerable areas of it have been found and mapped in the Caddo area, Louisiana.

The third division, comprising the Red River bottoms, is represented by a single soil series, the Miller series, of which two types are found, the Miller clay and the Miller fine sandy loam. The material from which these soils are derived is composed mostly of particles transported from the Permian Red Beds, on the headwaters of the Red River, more or less mixed with the sands, silts, and clays of more local origin. The clay contains considerable carbonate of lime, coming from a formation which is itself calcareous. The surface of the Red River bottoms is nearly flat, or at most of only gradual, slight slope away from the river banks toward the hills. The drainage near the base of the hills is poor, and at times of high water the crops there suffer most. The soil types here represented are alluvial in origin and are common throughout the Red River Valley.

Fifteen soil types were found in the area, the actual and relative extent of each being shown in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil	Acres.	Percent.
Norfolk fine sandy loam.....	191,424	31.1	Orangeburg fine sandy loam.	5,440	0.9
Susquehanna fine sandy loam	163,584	26.6	Orangeburg sand.....	4,544	.7
Meadow.....	111,168	18.1	Miller clay.....	2,240	.4
Caddo fine sandy loam.....	49,408	8.1	Greenville loam.....	2,048	.3
Susquehanna clay.....	33,272	6.2	Houston clay.....	1,728	.3
Orangeburg fine sand.....	27,072	4.4	Norfolk sand.....	704	.1
Greenville gravelly sandy loam.....	10,752	1.8	Miller fine sandy loam.....	640	.1
Norfolk fine sand.....	5,504	.9	Total.....	614,528

MILLER CLAY.

The Miller clay consists of about 8 inches of brownish-red or chocolate-colored silty clay, underlain to a depth of 3 feet or more by a stiff, tenacious, heavy, plastic red clay. When first broken it is a very difficult soil to turn with the plow, but if care is taken to plow deep and when the proper moisture condition exists, it becomes mellow and rather friable, especially if coarse manure, straw, or pea vines are turned under for a year or so.

This type of soil is confined to that portion of the area bordering the Red River and extending for a few miles up Saline Bayou, which is a large tributary of that river and subject to backwater during high floods. The soil is alluvial in origin, the material having been eroded from the Permian Red Beds along the headwaters of Red River and carried down in suspension and spread out over the flood plain of the river during periods of overflow. The coarser material thus carried down was often deposited near banks of the river and resulted in building up a low sandy ridge, while farther back from the main channel of the river, where the current of the flood waters was sluggish, the finer material, like silt and clay, was deposited. These fine silty and clayey deposits constitute the type Miller clay in the present area.

Lying about 40 feet above low water in the Red River this type is seldom subject to overflow, though it is somewhat lower than the narrow sandy ridge which is often found on the immediate banks of the river. Next to the base of the upland hills the natural drainage conditions are such as to give rise to small stretches of swamps and brakes. The drainage from the uplands, instead of taking a straight course toward the river, is usually diverted and runs parallel to it, passing from one small swampy area to another, until finally it cuts through the sandy ridge and enters the river. The greater part of the Miller clay has been cleared, drained, and placed in cultivation, and the unreclaimed portion could easily be cleared and drained if economic conditions justified it. The original forest was a heavy growth of hardwoods—oaks, gum, and considerable cypress—with a dense undergrowth of vines, briars, and small shrubs.

Unusually well adapted to cotton and corn, it is used mainly in the production of these crops, the former averaging about 1 bale per acre and the latter ranging from 25 to 35 bushels per acre under ordinary conditions and without special care or attention. The type is usually farmed in large plantations, and for many years cotton and corn have been the only crops grown. There has been no system of rotation, except cotton one year and corn the next, and the soil is naturally so productive that the need of commercial fertilizer or the growing of cowpeas or other legumes has never been

seriously felt. Owing to the flat, level surface of the fields and the stiff, clayey nature of the soil and subsoil, it is always late in the spring before cotton can be planted and equally late in the year before the crop can be gathered. Lateness of planting is a condition especially favoring the ravages of the boll weevil, and as a result the plantations upon this soil have suffered more from that pest than upon any other type in the area. The labor has become demoralized, and large plantations are growing up to grass, weeds, and briers, while the value of land has dropped to nearly half what it was a few years ago. Noting the success of farmers in other parts of the Red River Valley in growing alfalfa, some of the farmers in this area are now turning attention to that crop. Where the drainage conditions are naturally fair or have been made so by artificial means, very satisfactory results have been attained, but where the conditions are such that water collects and stands after a rain the crop has been an absolute failure. The farmers are learning that the greatest care and attention in the matter of drainage is necessary if a success is to be made with this crop. Under the best and most favorable conditions the crop has been cut from three to four times during the season, with an aggregate yield of about 4 tons per acre. Owing to the dampness of the climate and the frequency of showers considerable difficulty is being experienced in curing the crops. It is believed, however, that this is a condition which could be largely overcome by making use of hay caps. There is usually a great demand for alfalfa hay, and the farmers find no trouble in disposing of the crop at prices ranging anywhere from \$12 to \$20 a ton. Some farmers in the Red River Valley have found that by proper management the profits from growing alfalfa upon the Miller clay are sufficiently large to enable a person to buy the land on credit and pay for it in from two to five years. Either Bermuda grass or Japan clover does very well under conditions favorable for alfalfa, but an equal mixture of Japan clover and Bermuda grass seems to be more popular than either separately. The average yield for the season is about $2\frac{1}{2}$ tons per acre. A few farmers are turning their attention to hog raising, and thus in a measure avoiding too great dependence upon cotton. They are considering the possibilities of raising the hogs upon alfalfa pasture and producing enough corn to fatten them before killing. It is believed that there are great possibilities in this direction.

Only 2,240 acres, or about one-half of 1 per cent of the area, is occupied by this type, but at one time nearly as much cotton was produced upon it as upon all other soil types in the parish. This, however, was largely due to the fact that the first settlements in the region took place along the Red River, while a large part of the balance of the parish is still in virgin pine forests.

Prior to 1865 the soil was all in large plantations, but in recent years many of these have changed hands and been divided into smaller holdings. Some of the present owners still hold large tracts, and the usual method of farming them is to parcel out small areas to negro tenants. Under this system the preparation of the soil and the handling of the crop is usually careless and wasteful, unless the closest supervision is maintained. The plowing is very shallow, and this with clean cultivated crops year after year has so reduced the organic content of the soil as to increase greatly its natural tendency to puddle in wet weather and to bake and crack in dry weather. It is recommended that in the preparation of the ground the soil be plowed deeper and that a regular system of rotation be established in which cowpeas should find a place. It is also recommended that the peas be sown between the corn rows during the summer. The roots will loosen up the soil and subsoil and lessen the tendency to puddle and bake, besides making the fields productive through the addition of organic matter and nitrogen.

The following table gives the results of mechanical analyses of the soil and subsoil of the Miller clay:

Mechanical analyses of Miller clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18177.....	Soil.....	0.2	0.5	0.7	5.0	21.2	57.7	14.9
18178.....	Subsoil.....	.0	.2	.4	8.6	21.5	32.6	36.9

MILLER FINE SANDY LOAM.

The soil of the Miller fine sandy loam is light brown in color and ranges in texture from a fine sand to a fine sandy loam. Its depth varies from 8 to 20 inches, with an average of about 15 inches. The subsoil to a depth of 36 inches consists of reddish-colored silty fine sandy loam. The type in general possesses a loose, open texture, which allows the ready percolation of water, and it is an easy soil to plow and cultivate.

Though of alluvial origin, it at present is seldom subject to overflow, being about 40 feet above low water. It occurs as a natural levee near the banks of the Red River and the lower course of Saline Bayou. Its width varies from a few rods to about one-fourth mile. It slopes both toward the Red River and inland toward the area of Miller clay, and this, together with the slight irregularities of surface and loose, open texture of the soil, insures excellent drainage. The original source of the material is the same as that of the Miller

clay, viz, the Permian Red Beds, the chief difference lying in the larger size of the particles, which has caused a quicker deposition on slackening of the stream currents, and resulted in building up areas of the type upon the immediate banks of the river.

The Miller fine sandy loam is very well adapted to cotton, corn, and all sorts of garden truck, like strawberries, radishes, onions, cabbage, collards, turnips, and watermelons. Cotton and corn are practically the only crops grown at present. Where the boll weevil is active this soil is considered much more desirable for cotton than the Miller clay, for the reason that it is an early soil and the cotton has a chance to get well toward maturity before the weevil appears in destructive numbers. Ordinarily it produces larger cotton plants than does the Miller clay, but usually they do not fruit as well as on the latter. In ordinary years cotton yields about 1 bale per acre. It is considered slightly better adapted to corn than is the Miller clay, and the maximum yield is about 40 bushels per acre, with an average of about 30 bushels. On the other hand, it is not considered as desirable for alfalfa, Bermuda grass, or Japan clover as is the Miller clay.

The method and practices with regard to plowing, planting, cultivation, and rotation are practically the same as upon the clay adjoining—either cotton one year and corn the next or cotton for two or three years in succession. Shallow plowing and cultivation are generally practiced, but it is seldom that the crops suffer from droughts. Considerable difficulty, however, is experienced with vines and weeds, and in order to clear the land of these an occasional deep plowing is recommended. It is also suggested that enough fruit and vegetables be grown upon this type to supply the home and local market demands.

The Miller fine sandy loam is practically all under cultivation. The value ranges from \$25 to \$40 an acre. It is an important type in the Red River Valley, but occurs in such small areas in Winn Parish as to have little influence upon the agricultural conditions and values of land in the area as a whole.

The following table gives the results of mechanical analyses of the soil and subsoil of the Miller fine sandy loam:

Mechanical analyses of Miller fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18181.....	Soil.....	0.0	0.2	0.2	19.2	32.3	43.7	5.3
18182.....	Subsoil.....	.0	.3	.9	32.6	28.4	32.2	4.9

SUSQUEHANNA CLAY.

The soil of the Susquehanna clay consists of a brownish-red or red clay loam with a depth of about 4 inches, the first 2 inches being darker in color, owing to an accumulation of organic matter—the decayed remains of leaves and grass. The subsoil is a stiff, tenacious, plastic red clay to depths varying from about 20 inches to 3 feet, below which it usually becomes mottled with drab and gray. The proportion of the gray and drab colors increases, until at a depth of 5 or 6 feet the red color often disappears.

Because of the abundance of easily tillable sandy soils in the region, and the great difficulty of plowing and cultivating the Susquehanna clay, it is held in low esteem and practically none of it has ever been put in cultivation. It occurs in rather large areas southwest of Calvin and also in the region west of Tannehill and Dodson. Another area, though not as typically developed, occurs east of Packton. It is also found in small, isolated patches in other parts of the parish.

In topography the Susquehanna clay varies from nearly level to rolling, and in places artificial drainage would be necessary if the land were placed in cultivation. It is a residual soil derived principally from the Lower Claiborne formation. There are in some places a good many clayey iron concretions strewn upon the surface and in others some broken fragments of fossiliferous clay ironstone were observed.

The type is often spoken of as "hog wallow" or "post-oak flats." Scrubby post oak, black-jack oak, some shortleaf pine and "hog" haw are the characteristic trees upon it. A few farmers have at different times brought small patches of this soil under cultivation where it adjoins or is a part of fields made up of other types of soil, and no one was found who did not believe that the type is naturally a very productive one, if it can be handled properly. It is not likely that the Susquehanna clay will be cultivated to any great extent in the near future, but if the region eventually becomes thickly settled and land becomes much higher in price it is believed that this type will become more popular and its value will be more fully recognized.

In cultivating the soil both surface and tile drainage will be necessary to get the best results, and an abundance of organic matter, like coarse manure and pea vines, if turned under, will do much to mellow the soil and lessen its tendency to bake and crack in dry weather. It is believed that it would make excellent land for the production of native hay, and if pastured only when in proper condition would be excellent for pasture grasses. Oats are said to do very well upon soil of this character.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Susquehanna clay:

Mechanical analyses of Susquehanna clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18215, 18217.....	Soil.....	1.7	2.5	1.4	8.1	25.5	37.1	23.6
18216, 18218.....	Subsoil.....	1.3	1.3	.6	4.0	17.7	27.2	47.4

SUSQUEHANNA FINE SANDY LOAM.

The soil of the Susquehanna fine sandy loam ranges from a fine to medium, loose-textured gray sandy loam to a gray loamy fine sand. In depth it varies from 6 to 18 inches, the average being about 12 inches. Sometimes there are numerous iron concretions and fragments of iron crusts strewn upon the surface of the hills. The subsoil is usually rather impervious, and in the virgin state the arrangement of the overlying soil materials is interesting. The finest materials, like silt and very fine sand, will be found immediately overlying the subsoil, while above will come the coarser grades of sand. In fields that have been cultivated for several years this arrangement of soil materials is broken up, the surface soil has become homogeneous, and the line of demarcation between the soil and subsoil is sharp and distinct.

The subsoil of this type is composed of a very plastic, tenacious, red or mottled red and gray clay. Very frequently the subsoil is a heavy, plastic, tenacious red clay to a depth of 30 inches, below which the clay becomes mottled with gray or drab and the deeper one goes below 30 inches the more pronounced the gray color becomes, until at a depth of 4 or 5 feet the subsoil is usually sandier and much lighter colored. Indeed, there is almost always an appreciable quantity of very fine sand and silt in the subsoil, though the heavy plastic nature of the material as a whole gives it an impervious character. Except in eroded spots on the hills, where the subsoil is exposed, the type is a very easy one to plow and cultivate. In newly cleared fields the soil is darker colored and more loamy than is usual after a year or so of cultivation, when these characteristics gradually disappear and the soil assumes a closer structure and is not readily kept in good tilth unless means have been taken to maintain the content of organic matter.

In all of the more elevated portions of the area the Susquehanna fine sandy loam is found, and it is especially well developed in the region south and west of Winnfield. It is of wide extent in the large drainage basins and along the divides between these where the conditions have resulted in active weathering and erosion. Its surface is

rolling to hilly, and often it is badly dissected and irregular, this being especially the case along the upper reaches of the small streams. The drainage is inclined to be excessive, and owing to the usual rough topography great care is necessary in order to keep the sand from washing off the surface of the cultivated fields and exposing the subsoil. Owing to the plastic, impervious nature of the subsoil and the usual sandy, loose nature of the soil, the water-holding capacity of the type is not great, and for this reason much of the rain water is not absorbed, but runs off over its surface. This causes excessive erosion and accounts for the usual rough, irregular surface of the type as a whole.

The Susquehanna fine sandy loam owes its origin to the weathering of the sands and clays of the Claiborne Eocene formation. Less than 1 per cent of the type is in cultivation, and it is still covered with its original forest growth of post oak, black-jack oak, shortleaf pine, and dogwood. It is characterized by numerous post-oak and black-jack oak thickets. When it lies well and is carefully prepared and cultivated, it is a good soil for all of the general farm crops of the region. Cotton and corn are the principal products, and it is considered a little better for these crops than is the Norfolk fine sandy loam, for the reason that it can be built up and the effects of fertilization are much more lasting than upon the latter type. When the land is "fresh"—that is, just cleared—and contains an abundance of humus and organic matter, it produces from two-thirds to three-fourths bale of cotton and from 25 to 35 bushels of corn per acre, but after three or four years of continuous cropping the yields usually fall to about one-third bale of cotton and 12 bushels of corn per acre. This soil is also well adapted to truck crops, and where the sand is over 5 inches deep it is believed that certain grades of bright tobacco and also peaches could be successfully produced.

Shallow plowing and ridge cultivation are practiced on this type as on the other soils of the parish. Deeper plowing is particularly to be desired in this case, as loosening up the impervious subsoil will increase the water-holding capacity of the soil and thereby lessen the tendency to wash. For the same reason a system of rotation in which cowpeas or some other leguminous crop is included should be followed. The type is an excellent one for oats, and the following rotation is suggested: Cotton one year, corn the following year, and oats the third year. Sow cowpeas at the last cultivation of the corn and in the third year sow cowpeas as soon as the oats are harvested. Always plow deep, and this, together with the above rotation, will not only maintain the original productiveness, but tend to prevent washing of the soil. About 27 per cent of the area—163,584 acres—is occupied by this soil, so that it has a great influence upon the agricultural conditions in the area. A large percentage of the soil is held

by outside lumber interests and sells with the timber at \$15 to \$25 an acre. Cleared land for farming purposes ranges from \$5 to \$15 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Susquehanna fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18221, 18223.....	Soil.....	0.1	0.6	0.6	29.1	30.4	32.9	6.3
18222, 18224.....	Subsoil.....	.0	.2	.3	10.5	32.8	27.9	28.1

NORFOLK FINE SAND.

The soil of the Norfolk fine sand consists of about 8 inches of gray to light-brown loamy fine sand. There is usually no distinct line of demarcation either in color or texture between the soil and the subsoil, but the one grades into the other and changes by imperceptible degrees with increasing depth, until at 24 to 36 inches the material consists of a light-brown or reddish-brown sticky fine sandy loam. The reddish color of the subsoil is more pronounced on the crests of slight elevations, the color in leveler areas being lighter. Where this soil grades into the flat woods and swamp lands the subsoil is often slightly mottled with drab.

This alluvial soil is found associated with the larger streams in all parts of the parish, and is locally known as "hammock" land. Sometimes it is found as a small islandlike elevation, surrounded on all sides by swamp. In such instances it is called "first hammock." Again it may be associated with the second bottoms, or what is locally called "flat woods," and in such cases it is called "second hammock." Slight elevations in the low-lying leveler areas of Norfolk fine sandy loam often have many of the characteristics of "hammock" land and are often designated by the people as "third hammocks." Of these three different kinds of "hammock" land, the first is the one which occurs in the largest areas, is held in highest esteem by the farmers, and is representative of the type. The subsoil of the "second hammock" land is inclined to be somewhat lighter colored, more "crawfishy" and more "seepy" than the typical soil. As a whole it is an easy soil to plow and cultivate, and may usually be prepared and planted earlier than the Norfolk fine sandy loam. It was among the first soils to be cleared and put under cultivation.

In surface features it varies from nearly level to rolling, and owing to this and the porous structure of both soil and subsoil its drainage is naturally good. It is seldom if ever subject to overflow, but some-

times is cut off from the main land by inundation of the surrounding swamps.

In the early days these areas were sought out and cleared, because they were considered desirable for home sites and because of their convenience to the large hog and cattle ranges in the near-by swamps. The soil is naturally a productive one, and well adapted to cotton, corn, fruit, and vegetables. It is used exclusively for cotton and corn, and in growing these crops no definite system of rotation is practiced. The average yield for cotton is one-half bale, while that for corn is about 20 bushels per acre. Much larger yields are possible, but the soil has been cultivated continuously for so long that its productiveness is reduced at least one-third. The same rotation is recommended for this soil as for Norfolk fine sandy loam. It is believed that the soil would be an excellent one for peaches, strawberries, and watermelons, besides all kinds of light truck. Owing to the limited area occupied by this type it has no great influence upon the agricultural condition or upon the general value of land in the parish.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Norfolk fine sand:

Mechanical analyses of Norfolk fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18185, 18189.....	Soil.....	0.2	0.9	0.4	34.9	16.4	40.4	6.4
18186, 18190.....	Subsoil.....	.0	.2	.2	25.9	19.1	39.1	15.5

CADDO FINE SANDY LOAM.

The surface soil of the Caddo fine sandy loam to an average depth of about 12 or 15 inches consists of an ash-gray or drab-brown, compact, very fine sandy loam, containing so high a per cent of silt that it is frequently difficult to determine from a field examination whether it is a very fine sandy loam or a silt loam. Occasionally the texture of the surface material is uniform to a depth of 20 inches. The subsoil consists of a gray, sometimes chalky, compact, impervious material, which varies in texture from a silty very fine sand to a silty clay. Below this, at depths ranging from 18 to 36 inches, the material increases in the content of silt and clay, and the usual ash-gray color becomes mottled with streaks of drab, yellow, and sometimes of brown and red, and in these lower depths iron concretions are sometimes present.

None of the Caddo fine sandy loam is in cultivation, but as far as the texture of the soil is concerned it would be an easy one to plow and cultivate. It is found in all of the larger stream valleys of the

area. It is not an alluvial soil, however, but is probably derived from the Port Hudson, and therefore deposited in Quaternary times when these old valleys were submerged. The only original difference between this type and the unassorted material of the Norfolk fine sandy loam, which lies at a higher elevation, is that caused by the assorting power of water. The difference in elevation and the effects of weathering, erosion, and rain wash have since made the difference between these two types more pronounced.

The surface features of the Caddo fine sandy loam vary from flat to mounded and gently rolling. Upon the one side it merges gradually into the swamp areas, while toward the uplands it gradually gives place to the more rolling areas of Norfolk fine sandy loam. Its elevation above the swamp lands varies from a few feet to about 25 feet, but it is never subject to overflow from the swamps. The hummocky areas are composed of numerous mounds seldom 50 feet across and never more than 3 or 4 feet high. The material on the mounds is somewhat sandier than the intermound spaces.

The soil is naturally poorly drained because of its generally flat surface, lack of established drainage ways, and the impervious character of the subsoil. During the wet season water usually stands on the surface for weeks at a time, and finally disappears mainly through gradual seepage into the swamp areas and through evaporation. The surface material sometimes becomes so thoroughly saturated with water to a depth of 20 inches that it becomes boggy and an auger can readily be pushed through it to that depth. Upon boring below 20 inches, however, and sometimes less it will be found that the subsoil is so dry and compact that it is exceedingly difficult to turn the auger in it, notwithstanding the fact that the surface above is covered with water. This soil is similar to the Hammond silt loam which occurs in large areas in Tangipahoa Parish and upon which, by proper drainage and the heavy application of fertilizers, the strawberry industry has proven to be very profitable. In handling this soil thorough surface drainage is absolutely necessary in order to remove the standing water. There is always sufficient fall toward the swamp areas to insure good drainage through open ditches and canals. It is believed, too, that the type is well suited to the production of rice if some means could be devised to furnish water for the necessary flooding, and there are apparently many locations where the necessary water could be obtained, either by pumping from near-by streams or by diverting the water from these streams a few miles above and leading it through canals to the fields.

At present the Caddo fine sandy loam is wholly in forest. The mounded phase constitutes a very small proportion of the whole, and in such places the timber is made up of longleaf and shortleaf pine. The usual timber growth, however, is pin oak, white oak, post oak,

black oak, and shortleaf and loblolly pine. The soil is locally known as "flat woods" and "pin-oak flats."

It is not probable, even when cleared, that this soil will be well adapted to the general farm crops of the region, but it may be made excellent permanent pasture land, and also has good possibilities for special crops like strawberries, rice, and probably sugar cane.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Caddo fine sandy loam:

Mechanical analyses of Caddo fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18157, 18159.....	Soil.....	0.2	0.4	0.2	19.3	27.4	47.9	6.1
18158, 18160.....	Subsoil.....	.1	.3	.2	16.5	27.3	44.3	11.4

HOUSTON CLAY.

The soil of the Houston clay is a brown to black clay ranging in depth from 4 to 8 inches. The subsoil to a depth of 3 feet or more consists of a greenish-yellow clay, usually containing many white chalky lime concretions about the size of a pea. Scattered upon the surface and disseminated throughout the soil and subsoil are found fragments of impure fossiliferous white limestone, varying from 2 to 6 inches in diameter. These, however, are never numerous enough to interfere with cultivation.

In the small patches between St. Maurice and Calvin the Houston clay is especially well developed. It is also found west of Dodson, on Antwine and Big creeks. It is in these localities that the fragments of fossiliferous limestone occur, and the fossil evidence seems to indicate clearly that they are Lower Claiborne in age. In the region near Prairie Home there is another area of the type, but in this no limestone rocks occur. There is, however, considerable gypsum in the form of crystals. According to Harris the Houston clay in this vicinity is probably of Eocene age, but derived from the Jackson formation. The soil seems to be always associated with areas of Susquehanna clay.

The surface of the Houston clay is usually level to rolling. Along Antwine and Big creeks it occurs in depressed areas just above the overflow land of these streams, and in order to get the best results from it the farmers have found it necessary to construct open ditches to carry off the water from the adjoining hills. Ordinarily, however, it is rolling enough to insure good surface drainage.

In origin the Houston clay is residual, being derived from the weathering of the underlying unconsolidated layers of marls and

chalky clays of Eocene age and of either the Lower Claiborne or the Jackson formation. The lime rock found in the type represents hard, resistant portions of the underlying material. Heretofore this type has usually been associated with the Cretaceous limestones and has occurred especially well developed in the black land belt of Texas. Its occurrence in the basal horizons of the Tertiary is accounted for by the fact that in the earlier Tertiary there were doubtless places where the conditions were similar to those existing in the Cretaceous and these brought about similar depositions. Portions of the type have never been forested and are known as prairie. Other areas originally had a mixed growth of white oak, red oak, some hickory, shortleaf pine, and several varieties of thorny shrubs.

Owing to the great abundance of easily worked sandy land in the parish, the small isolated patches of this soil, the difficulty of plowing, and its tendency to wash badly it is not held in high esteem for farming land. The farmers are accustomed to plow with one horse, and since it is impossible to break this soil satisfactorily unless two or more heavy horses are used, it has never been in great favor. A few, however, recognized its value in growing cotton, corn, and also hay crops. The average yield for cotton is about 1 bale per acre, but the yields range anywhere from three-fourths bale to $1\frac{1}{4}$ bales. The yield of corn is from 35 to 60 bushels per acre, with an average of about 40 bushels. Bermuda grass, crab grass, and Japan clover are the only hay and pasture crops grown thus far. It is believed that where the drainage conditions are satisfactory alfalfa would be more satisfactory and more profitable than any of these.

Commercial fertilizers apparently do not produce any marked increase in crop yields, but decidedly beneficial results have been obtained from growing cowpeas, which seem to loosen up the soil, make it more productive, and less liable to severe washing.

One of the most serious difficulties in cultivating the Houston clay is to prevent erosion, especially in areas that are rolling or slightly hilly. Clean cultivation year after year, without the addition of coarse material like barnyard manure or pea vines, is largely responsible for its tendency to wash, and the application of manure and growing of cowpeas or some other legume are strongly recommended. Deep plowing and frequent cultivation will also assist the soil in absorbing the rainfall and to this extent reduce the run-off.

Because of its limited extent the Houston clay has little agricultural value. In bodies of 25 to 100 acres this type would sell for about \$35 an acre.

The following table gives the results of mechanical analyses of this type of soil:

Mechanical analyses of Houston clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18171.....	Soil.....	1.6	2.6	1.4	4.0	5.6	54.2	29.6
18172.....	Subsoil.....	.7	1.0	2.6	10.6	12.0	42.9	29.9

The following sample contained more than one-half of 1 per cent of calcium carbonate (CaCO_3): No. 18172, 35.09 per cent.

NORFOLK FINE SANDY LOAM.

The soil of the Norfolk fine sandy loam, to a depth of 8 or 10 inches, is a gray or brownish-gray fine sandy loam or a loamy fine sand of the same color. In areas which have never been in cultivation the soil grades imperceptibly into a subsoil of yellowish color, the texture of which usually becomes a sandy clay at a depth of about 30 inches. In cultivated fields the color difference between the soil and subsoil is usually quite distinct. The usual color of the subsoil is yellow, but in many cases on the crests of slight elevations where the drainage conditions are unusually perfect it is slightly reddish yellow or chocolate yellow. In such locations, too, the texture of the subsoil is inclined to be somewhat more clayey. In depressions and flat, poorly drained spots the color of the subsoil below 30 inches is usually yellow mottled with drab, and here the texture of the subsoil is often slightly more sandy than the typical subsoil.

The Norfolk fine sandy loam is easy to plow and cultivate, both because of its texture and gentle topography, but owing to its usual location upon the lower slopes and the low, gently rolling divides it does not drain as readily as some of the other types in the parish, and consequently crops can not usually be planted as soon. This condition, however, is one easily remedied by artificial drainage. The water-holding capacity of the soil is rather above the average, and in a droughty season crops suffer much less upon this than upon the higher lying, sandier soils.

The Norfolk fine sandy loam is derived largely from the Lafayette formation—a mantle of sandy material deposited upon the older Eocene sediments when the region was depressed below the level of the Gulf. In some localities, however, it seems to owe its origin to the direct weathering of the sandy layers of Eocene age.

About 299 square miles, or 31.1 per cent of the parish, is composed of the Norfolk fine sandy loam, so that in point of area it is an important type. However, a very small proportion of it is in cultivation, the remainder being virgin forest. The growth is composed mostly of shortleaf and loblolly pine, with a sprinkling sometimes of

longleaf pine, maple, and white oak. In the "gladey" places a few black gum trees are found.

Small patches of the more rolling, better-drained portions of the type are in cultivation. On these cotton, corn, and sugar cane are practically the only crops. It is not a strong soil, but for two or three years after clearing it will produce on the average about two-thirds bale of cotton and 20 bushels of corn per acre. After the virgin humus is exhausted the crop yields decrease rapidly, unless manures are applied and a proper crop rotation is followed. Under the present conditions of farming cotton yields from one-fifth to two-thirds bale per acre, with an average of about one-half bale per acre, and corn from 8 to 20 bushels, with an average of about 12 bushels per acre. The soil is well adapted to growing sugar cane, but as yet it has been produced only for home use, with yields ranging from about 150 to 250 gallons of sirup per acre.

As already intimated, the soil needs constant care and attention in order to maintain its productiveness. Applications of fertilizers, either commercial or home products, are not very lasting, and in order to get the best results it is necessary to make applications every year. The most satisfactory results have been obtained by the few who make a practice of sowing cowpeas upon the land as frequently as possible. It is believed that the farmers would do well to adopt the following rotation: Sow oats and after the harvest sow cowpeas, plow the ground during winter months and plant to cotton the following spring. The next year plant corn and put the rows far enough apart so as to permit sowing a row of cowpeas in the middle. By this scheme of rotation, or by some similar plan, it is believed the productiveness of the type could be maintained.

When the region develops and market conditions improve this type of soil will have great possibilities in the production of truck.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Norfolk fine sandy loam:

Mechanical analyses of Norfolk fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18191, 18193.....	Soil.....	0.3	0.6	3.2	19.4	38.8	30.9	6.6
18192, 18194.....	Subsoil.....	.1	.4	2.8	16.1	35.6	24.7	19.8

NORFOLK SAND.

The material composing the Norfolk sand is made up of gray and white incoherent sand of prevailing medium texture to a depth of 36 inches. In the lower depths of the material there is a tendency

toward a yellowish color and this is more pronounced in the areas that occur adjacent to Saline Bayou. Where the soil occurs on the hills, however, the color of the subsoil is yellowish at 36 inches, but becomes reddish below that point.

The Norfolk sand occurs principally in the western part of the parish, along Saline swamp and upon the rolling hilltops a mile or so back from that swamp. Owing to its loose, open texture it is easy to till. In surface features it varies from nearly level to gently rolling upon the lowland areas lying in the Saline bottoms to hilly and rolling in the upland areas. The drainage is inclined to be excessive in the uplands, and crops are apt to suffer severely during dry weather. In the lowland, where the water table comes close to the surface, crops are affected little by ordinary periods of drought.

Because of the unfavorable moisture conditions prevailing over much of its areas, very little of this type is under cultivation at present. Only a few patches here and there along Saline swamp have been cropped. The soil is not naturally a very productive one, and the effects of fertilizers are not lasting. Cotton and corn are at present the only crops, the yield of the former being about one-third bale per acre, and of the latter about 15 bushels per acre. Crops can be planted upon this soil earlier than upon any other type in the area, and now that the early planting of cotton has become so necessary in combating the boll weevil, it is suggested that more of this soil could well be used in cotton production. By following a system of rotation designed to add organic matter to the soil (and this can best be done by including some of the legumes, preferably cowpeas) much larger yields of both cotton and corn are possible. The soil is very well adapted to the growing of all kinds of early light-truck crops as well as Irish potatoes, watermelons, and peaches.

Only a little more than 1 square mile of the soil occurs in the parish, but under the present conditions with respect to the boll weevil and the increasing demands of the near-by logging camps and saw-mills for fruit and vegetables, to which the soil is especially well adapted, it is destined to become an important factor in the agriculture of the western part of the parish.

MEADOW.

The Meadow includes that portion of the stream valleys subject to such frequent overflow as to render it unfit for farm crops of any kind at present. The material composing these bottoms is often quite variable in short distances, but is generally made up of a silty loam or a silty fine sandy loam.

The areas are found along all of the larger streams of the parish, but are especially conspicuous on Dugdemona and Saline swamps,

where areas varying from 1 to 2 miles in width were mapped. Under the present conditions such land has no value from an agricultural standpoint, except for the abundance of winter pasturage it affords. The Meadow has considerable value for its timber, which consists principally of white oak, red oak, pin oak, cypress, loblolly pine, red and white gum, hickory, ash, and beech.

GREENVILLE GRAVELLY SANDY LOAM.

The soil of the Greenville gravelly sandy loam varies from a gray fine sandy loam to a reddish fine sandy loam, and has an average depth of about 10 inches. The subsoil to a depth of 36 inches, and often to 4 or 5 feet, consists of a bright-red sandy gravelly clay, but, as shown in the road cuts, the material at a depth below 36 inches sometimes becomes mottled with yellow and drab. The gravel in the subsoil consists of ferruginous iron concretions, and these and fragments of iron sandstone are usually present in the soil and scattered upon the surface. On the hilltops, where the finer particles of sand have been washed off, the surface is often thickly strewn with this coarse material, the fragments varying from one-half inch to 6 inches in diameter, and the type is known locally as "red sandy gravelly land."

The Greenville gravelly sandy loam is an easy soil to plow and cultivate, and usually the fields are free of stumps, indicating that the type has been in cultivation a long time. Shortleaf pine and oaks were the characteristic native vegetation.

This soil is not of wide occurrence in Winn Parish, and is typically developed only in the northwestern part, in the vicinity of Gansville. To the northward, in the adjoining parishes, it becomes an extensive soil type and one which has contributed largely to the wealth of northwestern Louisiana and southern Arkansas.

The usual topography of the soil is rolling to hilly, and owing to this and to the somewhat open nature of the subsoil the drainage is naturally good. The type has been derived from the weathering of sands and sandy clays of the Lower Claiborne formation, and the few rock fragments found upon the surface have been formed from the hardening of the sandy layers and are not the fragments of indurated rock formations. The soil is characterized by its high content of iron, the presence of large quantities of iron concretions and iron crusts being evidence of this. The iron occurs as brown hematite and limonite ores, but not in sufficient quantities to be of economic value.

The Greenville gravelly sandy loam is moderately productive of all the general farm crops of the region, and besides is especially well adapted to peaches, small fruits, vegetables, and truck crops. In the early days a fine grade of tobacco is said to have been produced for

home use, but at present none is grown. The average yield of corn is about 20 bushels, and of cotton one-half bale per acre. With careful cultivation much better yields of both are possible. At present not many peaches are grown, but the quality of those produced and their good size and fine color indicate that the peach industry would prove very successful and profitable. It is likewise probable that tobacco growing could be made a paying industry.

Owing to the desirability of this type for general farming, it is nearly all cleared and under cultivation and well improved. For these reasons, although it is rather limited in area, it is considered an important agricultural soil. The average price of the farms ranges from \$15 to \$20 an acre.

The following table gives the results of mechanical analyses of the soil and subsoil of the Greenville gravelly sandy loam:

Mechanical analyses of Greenville gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18211.....	Soil.....	1.4	2.8	4.3	37.0	21.8	29.6	3.9
18212.....	Subsoil.....	1.3	1.7	2.0	33.8	17.9	13.9	28.8

GREENVILLE LOAM.

The Greenville loam consists of 3 to 5 inches of brownish to reddish loam or silt loam, underlain by a friable, heavy red clay loam that extends to depths ranging from 24 to 36 inches. Below this the color of the material changes to mottled red and yellow. The subsoil has a somewhat greasy feel when rubbed between the fingers as though composed in part of shale. It always contains a considerable quantity of very fine iron concretions, which tend to make the structure more open and to facilitate aeration and the movement of the soil water.

When handled under proper conditions of moisture, the soil turns easily and no unusual difficulty is experienced in the preparation of an excellent seed bed. If plowed when too wet, however, a great deal of trouble is experienced in subsequently securing good tilth.

The Greenville loam occurs only in small areas in the vicinity of Gansville. It is locally known as "red land" or "mixed land." The latter term results from the association of this soil with the Greenville gravelly sandy loam and the Susquehanna clay and seems to represent a condition intermediate between these two types. It is prized very highly for cotton and corn. It occurs in larger areas in the adjoining parishes to the north and extends on into Arkansas.

The usual topography is slightly rolling to nearly level, the areas being associated with Susquehanna clay, which has similar topography. The drainage is only fair and, although the subsoil is kept

somewhat open and porous by the presence of numerous iron concretions, it is believed that the condition even of the subsoil would be greatly benefited by tile drainage.

The soil is derived from the weathering of the underlying beds of the Lower Claiborne formation.

Cotton yields range from one-half to 1 bale, with an average of about two-thirds bale per acre. Corn gives from 15 to 35 bushels per acre, averaging about 25 bushels. The soil is exceedingly well adapted to oats, but as they are always fed in the sheaf no definite idea of the yield of grain can be obtained. It is estimated that it would be over 40 bushels per acre. The Greenville loam is practically all cleared and under cultivation. It is considered a strong soil, susceptible of improvement, and readily maintained in a high state of productiveness when once in that condition.

As this soil occupies only a few square miles in this parish, it is not so important agriculturally as in some other parishes where it has a larger development. The average price of land of this type, including farm buildings and all improvements, is about \$20 an acre.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Greenville loam:

Mechanical analyses of Greenville loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18167, 18169.....	Soil.....	2.6	4.9	3.2	14.8	15.2	50.2	8.6
18168, 18170.....	Subsoil.....	.5	2.3	3.2	13.3	7.5	38.7	34.9

ORANGEBURG FINE SANDY LOAM.

The Orangeburg fine sandy loam consists of 6 to 18 inches of gray or brownish-gray fine to medium textured sandy loam, underlain by material which ranges from a red clayey fine sandy loam to a red fine sandy clay extending to a depth of 36 inches or more. Usually the line of demarcation between the soil and subsoil is quite distinct both in color and texture. In the forested areas, however, this is not always the case. The surface is occasionally strewn with a scattering quartz gravel.

Occurring in rather small disconnected areas, the Orangeburg fine sandy loam is found in all parts of the parish, and especially in the northern two-thirds. It occurs as hills and ridges, and has excellent natural drainage. Owing to its loamy texture, good drainage, and the usual absence of rough surface features, it is very readily brought under cultivation, and it was one of the first soils to be farmed by the early settlers.

The Orangeburg fine sandy loam is derived from the unconsolidated sandy and sandy clay formations which underlie it. These were probably deposited under conditions similar to those existing when the Lafayette was being laid down, though its origin may be of a much earlier date. Originally the land of this type of soil was covered with forests of longleaf and shortleaf pine, with some scattering red oak and hickory. Cotton and corn are the crops, and it is considered a good, safe soil for these in almost any season. The yield of cotton ranges from two-fifths to three-fourths bale per acre, with an average of about one-half bale. Corn ranges from 10 to 25 bushels per acre, with an average of about 20 bushels. It is considered a better soil for corn than for cotton. The above yields are those for crops without an application of commercial fertilizers. By using 200 or 300 pounds of fertilizers per acre, some farmers maintain an average yield of about two-thirds bale of cotton and about 25 bushels of corn per acre. Judging from vegetables and peach trees seen growing in gardens and the success of a few near the towns who have been growing truck on a small scale, the Orangeburg fine sandy loam is one of the best soils in the area for all kinds of small fruit and vegetables, and with the increasing demand for these products it is believed that it would be much more profitable to use the land for these crops than for cotton. In the early days the farmers grew their own tobacco upon this soil, and the success had in growing Cuban filler tobacco upon this same type of soil in Texas suggests that this crop might be profitably introduced here.

Elberta peaches grow to perfection upon this soil and this is another industry whose development is feasible.

The cultural methods on this soil are practically the same as on the other types of the parish. The advantages of deep plowing, of the rotation of crops, and of growing cowpeas or other legumes have been little appreciated. These matters, which have been discussed in connection with soils already described, should be given more consideration by the farmers.

Although the Orangeburg fine sandy loam occurs in rather small, isolated patches, these are so numerous and held in such high favor as to make it an important soil locally.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Orangeburg fine sandy loam:

Mechanical analyses of Orangeburg fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18203, 18205.....	Soil.....	0.1	0.5	2.5	54.4	13.4	23.4	6.3
18204, 18206.....	Subsoil.....	.1	.3	1.6	38.9	17.1	21.9	19.8

ORANGEBURG SAND.

The Orangeburg sand consists of 10 or 12 inches of light-brown or gray, medium to fine textured sand, underlain by material of the same texture, but of reddish color, extending to a depth of 36 inches or more. At about 24 inches the subsoil sometimes becomes slightly sticky. This is an easy soil to till, breaking into a pulverulent seed bed without tendency to pack or bake.

Small areas of Orangeburg sand are scattered here and there over the western third of the parish, the largest lying in the northwest corner. In topography the soil is rolling to hilly. It occurs upon the divides and narrow ridges of high elevation. This, together with the loose, open nature of the soil and subsoil, insures rapid drainage, which, if anything, is apt to be excessive. As a result land of this type is usually considered of low value in the production of cotton and corn. Over limited areas the surface features resemble sand dunes and, taken as a whole, the soil appears to be the remnant of an ancient beach line.

In some of the more level locations where moisture conditions are naturally the most favorable small areas of the type are sometimes successfully used for general farm purposes. In such locations light truck crops and watermelons seem to do exceptionally well, but in order to keep the soil in a productive state frequent applications of manure and fertilizers are necessary. No peaches were seen growing on the soil and if experimented with it is recommended that only the best and most productive portions of the type be tried.

Being of limited area the Orangeburg sand has little or no material influence upon the agricultural conditions and land values in the parish. Most of the type is still forested with its native growth of longleaf pine and chinquapin. The abundance of the latter and the presence of a weed known locally as "bull nettle" have given rise to the descriptive terms "chinquapin" or "bull nettle" land.

The greatest value of the type lies in its pine timber. Where this has been removed the land can be purchased for about \$5 an acre.

ORANGEBURG FINE SAND.

To an average depth of about 15 inches the soil of the Orangeburg fine sand consists of a light-brown very fine sandy loam. Below this and to a depth of 36 inches or more the material consists of a reddish-brown very fine sandy loam or silty fine sandy loam. Usually there is very little textural difference between the soil and subsoil, the difference in color being the most marked change.

The Orangeburg fine sand is found only in the western part of the parish, where it occurs as a narrow strip extending from the foot of Saline Lake to Petticore Bluffs schoolhouse. The usual topography is

rolling to hilly and the natural drainage is good, although the soil retains moisture very well. It is a residual type derived through weathering from some of the older formations of the Eocene period.

Not only is the Orangeburg fine sand an easily tilled soil, but it is at the same time well adapted to all of the general crops, truck crops, and to sweet and Irish potatoes. It is probably a good soil for the production of peaches and small fruit. The average yield of cotton is one-half bale, and of corn about 20 bushels per acre. Much greater yields, however, are attainable by special care and attention in the preparation of the seed bed and subsequent cultivation of the crop. The soil is very susceptible to improvement, and the effects of manures and fertilizers are both marked and fairly lasting. No crop rotation is practiced. The planters should follow a rotation of cotton, corn, and oats, with catch crops of cowpeas. The cowpeas should be introduced twice in the rotation, first to be sown with corn at the last cultivation, and again sown after the oats are harvested. By this plan the yields of crops can be much increased.

Some of the top has been subject to considerable washing, but this can be overcome to a great extent by growing some of the winter cover crops described under the head of "Agriculture." Terracing would prove very beneficial upon some of the steeper slopes, and side-hill ditches are always beneficial if carefully constructed. Where markets are available a fine opportunity is offered in growing Irish potatoes and watermelons on this soil.

A fair average price for the Orangeburg fine sand is between \$10 and \$15 an acre. It is, or has been at some time, all in cultivation. Though of rather limited extent it is one of the valuable soils of the parish.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Orangeburg fine sand:

Mechanical analyses of Orangeburg fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
18199, 18201.....	Soil.....	0.0	0.2	0.4	28.9	36.6	29.6	3.7
18200, 18202.....	Subsoil.....	.1	.3	.3	13.4	42.7	30.9	12.3

SUMMARY.

Winn Parish lies in about the center of northwest Louisiana, and the soils, agricultural practices, and conditions encountered there are representative of those which are common over a considerable part of the hill section of the State in the adjoining parishes to the east and south.

The area was settled about 1840 by white people from Kentucky, Tennessee, Alabama, Georgia, and Mississippi; and these people and their descendants were until about 1900 engaged almost exclusively in raising hogs and cattle. There was very little cotton grown.

The slow development of the parish was due almost entirely to the fact that it was remote from navigable streams, and until about 1900 no railways penetrated the parish. The recent great activity in lumbering and railway construction has stimulated development. More money is in circulation, higher wages are being paid, population is increasing, better schools are being built, and agricultural practices are improving to meet the increasing demands for farm products.

The climate of the parish, besides being well suited to the production of the staple crops of the South—cotton and corn—is also admirably adapted to growing small fruits and truck crops in general.

Only a small per cent of the land has ever been cleared and cultivated, but the present rapid removal of the timber will furnish great opportunities for settlement upon cheap lands and at reasonable terms.

The chief town and trading center of the parish is Winnfield. The parish as a whole now possesses excellent transportation facilities, and when the farm products exceed the local demands it is believed that no difficulty will be experienced in finding an outside market and obtaining reasonable freight rates.

Fifteen types of soil were recognized and mapped. The larger part of the parish is covered by fine sandy loams. The Norfolk, the Orangeburg, and the Susquehanna are the most important series represented. On some of the sandy types it is believed that peaches and a fine quality of cigar-wrapper tobacco could be profitably produced.

A systematic rotation of crops should be followed on all the soils of the area. On the upland sandy soils a three-year rotation of cotton, corn, and oats, with cowpeas sown both at the last cultivation of the corn and after the cutting of the oats, is suggested. All the soils need deeper plowing and a more thorough preparation of the seed bed. The heavy clay types should be tile drained, and a four or five-year rotation would be best upon them. Cowpeas should figure largely in all rotations. The growing of winter cover crops is strongly recommended. Level cultivation on well-drained lands, the use of the check-row system for cotton, the use of better farm machinery, and the growing of more forage crops are all strongly advised.

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